JOURNAL OF RESEARCH of the National Bureau of Standards—A. Physics and Chemistry
Vol. 74A, No. 2, March–April 1970

A Theoretical Investigation of the Configurations $(3d+4s)^4 4p$ in Neutral Vanadium (V I)

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(October 13, 1969)

Experimental levels of the configurations $(3d+4s)^4 4p$ in V I were compared with corresponding calculated values. On fitting 228 experimental levels by means of 20 free parameters an rms error in the calculated values of 216 cm^{-1} was obtained. All the 438 theoretically predicted levels and g-factors were calculated.

Key words: Configurations in V I; configurations $(3d+4s)^4 4p$ in V I; configuration interaction; energy levels of V I; first spectrum; g-values V I; parameters; theory; vanadium; V I; Zeeman effect.

1. Introduction

Racah and Shadmi [1, 2][1] investigated theoretically the configurations $(3d+4s)^n$ in the second and third spectra of the iron group. The configurations $3d^n 4p$ in the second and third spectra of the iron group, the configurations $(3d+4s)^n 4p$ for Sc II, Ti II, V II, Ca I, Sc I and Ti I, as well as the odd configurations of Cu II were investigated by the author [3–7].[2]

The configurations $(d+s)^4 p$ comprise 165 theoretical terms splitting into 438 levels. In AEL [8], 74 terms splitting into 223 levels are assigned to the configurations $3d^4 4p + 3d^3 4s4p$. In addition, 44 odd terms splitting into 119 levels are given without any configuration designation and an additional 36 odd levels are given with no term designations.

The initial values for the interaction parameters[3] were taken from the final results of Ti I, [6]:

$$
\begin{aligned}
B &= 560 \\
B' &= 660 \\
C &= 1{,}630 \\
C' &= 2{,}310 \\
G'_{ds} &= 1{,}650 \\
F_2 &= 150 \\
F'_2 &= 280 \\
G_1 = G'_1 &= 280 \\
G_3 = G'_3 &= 20 \\
G'_{ps} &= 5{,}800 \\
\alpha = \alpha' &= 50 \\
H &= 180 \\
J &= 1{,}500 \\
K &= 3{,}000 \\
\zeta_d = \zeta'_d &= 100 \\
\zeta_p = \zeta'_p &= 110
\end{aligned}
\tag{1}
$$

The initial values of A and A' were calculated from the electrostatic interaction matrices of ^{6}G, ^{6}F, and ^{6}P. These are given by:

$$^4\mathrm{F}(^3\mathrm{P})\,^6\mathrm{G}:\ A'-15B'-3G'_{ds}-F'_2-G'_{ps}-10G'_1-10G'_3+12\alpha'$$

$$
\begin{array}{l}
(^5D)\,^6\mathrm{F} \\ \\ ^4\mathrm{F}(^3\mathrm{P})\,^6\mathrm{F}
\end{array}
\left[
\begin{array}{c|c}
A-21B-2F_2-10G_1-20G_3+6\alpha & \frac{2\sqrt{5}}{5}(K-J) \\
\frac{2\sqrt{5}}{5}(K-J) & A'-15B'-3G'_{ds}+3F'_2-G'_{ps}-6G'_1-26G'_3+12\alpha
\end{array}
\right]
$$

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[1] Figures in brackets indicate the literature references at the end of this paper.

[2] The reader is referred to these papers for an explanation of the method used, notation and significance of the various parameters.

[3] Unprimed quantities refer to the configuration $3d^4 4p$, primed quantities to $3d^3 4s4p$ and doubly-primed quantities to $3d^2 4s^2 4p$. The numerical values of the parameters and levels are in cm^{-1}.

$$
\begin{array}{ll}
({}^5\mathrm{D})\,{}^6\mathrm{P} & \left[\begin{array}{c|c} A-21B-7F_2-35G_3+6\alpha & \\ & \frac{3\sqrt{5}}{5}(K-J) \\ \frac{3\sqrt{5}}{5}(K-J) & A'-3G'_{ds}-7F'_2-G'_{ps} \\ & -G'_1-21G'_3+2\alpha' \end{array}\right]; \\
{}^4\mathrm{P}({}^3\mathrm{P})\,{}^6\mathrm{P} &
\end{array}
$$

By using the values of the parameters in (1) and the fact that the trace of a matrix equals the sum of its eigenvalues, we obtain:

$$A' = 23{,}330 + z\,{}^6\mathrm{G}_{\mathrm{C.G.}}$$

$$A + A' = 36{,}370 + z\,{}^6\mathrm{F}_{\mathrm{C.G.}} + y\,{}^6\mathrm{F}_{\mathrm{C.G.}}. \tag{2}$$

$$A + A' = 26{,}520 + z\,{}^6\mathrm{P}_{\mathrm{C.G.}} + y\,{}^6\mathrm{P}_{\mathrm{C.G.}}$$

By using the values for the centers of gravity of $z\,{}^6\mathrm{G}$, $z\,{}^6\mathrm{F}$, $y\,{}^6\mathrm{F}$, $z\,{}^6\mathrm{P}$ and $y\,{}^6\mathrm{P}$ from AEL [8], and averaging, we obtain:

$$A = 40{,}185$$

$$A' = 40{,}050. \tag{3}$$

2. Results

After three iterations, the differences between the values of the parameters obtained in the least-squares calculation and the corresponding values in the diagonalization were very small.

The final values of the parameters obtained are given in table 1 together with their standard errors.

The rather high value of 345 for the rms error can be partly attributed to the fact that the interactions with the configuration $3d^24s^24p$ were not considered, as there are no experimental levels assigned to that configuration. An approximate value for the height of $3d^24s^24p$ can be obtained as follows.

Racah and Shadmi, [1, 9], have shown that if $M(d^n)$, $M'(d^{n-1}s)$ and $M''(d^{n-2}s^2)$ are the centers of gravity of d^n, $d^{n-1}s$ and $d^{n-2}s^2$ respectively, i.e., the weighted averages of the terms of these configurations, then the parameters

$$D' = M'(d^{n-1}s) - M(d^n)$$

and

$$D'' = M''(d^{n-2}s^2) - M'(d^{n-1}s)$$

are linear functions of n with small quadratic corrections for the configurations $(3d+4s)^n$ in the second spectra of the iron group.

TABLE 1. *Final parameters for* V I (3d + 4s)⁴4p

Parameter	$3d^44p+3d^34s4p$	$3d^44p+3d^34s4p+3d^24s^24p$
A	39,052 ± 250	39,458 ± 259
A'	40,666 ± 283	41,022 ± 272
A''	....	54,416 ± 757
B	555 ± 10	579 ± 12
B'	750 ± 6	730 ± 5
B''	....	881 (Arith. Progress.)
C	2,008 ± 26	2,084 ± 23
C'	2,540 ± 25	2,587 ± 19
C''	....	3,090 (Arith. Progress.)
G'_{ds}	1,495 ± 48	1,584 ± 33
$G = G'_{ds}$	....	1,584 (Equal)
F_2	194 ± 9	160 ± 8
F'_2	275 ± 7	282 ± 6
F''_2	....	404 (Arith. Progress.)
G'_{ps}	5,836 ± 76	6,022 ± 80
G_1	281 ± 10	229 ± 8
G'_1	296 ± 11	281 ± 8
G''_1	....	333 (Arith. Progress.)
G_3	9 ± 3	13 ± 2
G'_3	23 ± 4	13 (Equal)
$G''_3 = G'_3$	....	13
α	70 ± 3	54 ± 2
α'	70 (Equal)	54 (Equal)
$\alpha'' = \alpha'$	....	54
H	172 ± 8	150 ± 6
$H' = H$	....	150
J	1,088 ± 48	972 ± 48
$J' = J$	....	972
K	2,492 ± 42	2,468
K'	....	3,104 (Fixed Diff.)
$\zeta_d = \zeta'_d$	146 ± 29	141 ± 22
$\zeta''_d = \zeta'_d$	....	141
$\zeta_p = \zeta'_p$	124 ± 77	140 ± 78
$\zeta''_p = \zeta'_p$	....	140
rms error	345.3	215.8

Now, in d^np we must consider n interactions $d-p$, $n(n-1)/2$ interactions $d-d$ and the $L(L+1)$ correction. From p. 200 TAS [10], the center of gravity of dp is

$$M(dp) = F_0(dp) - (G_1 + 7/2G_3) \tag{4}$$

From eq (78) RII [11], and by taking into account α, the center of gravity of d^2 is

$$M(d^2) = A + 7/9\ (\mathrm{C} - 2B) + 32/3\alpha. \tag{5}$$

The $L(L+1)$ correction has to be considered as the combination of two-particle interactions, $[L(L+1) - 6n]\alpha$, and an additive constant $6n\alpha$, [12].

Then by writing

$$M(d^2) = A + 7/9(\mathrm{C} - 2B) + 12\alpha - 4/3\alpha \tag{6}$$

we have

$$M(d^n p) = [A + 7/9(C-2B) - 4/3\alpha]n(n-1)/2 + 6n\alpha + n[F_0(dp) - (G_1 + 7/2G_3)]$$
$$= A + (7n/18)(n-1)(C-2B) + (2n/3)(10-n)\alpha - n(G_1 + 7/2G_3), \quad (7)$$

where we have replaced $[n(n-1)/2]A + nF_0(dp)$ by A.

In the configuration $d^{n-1}sp$, we have in addition $(n-1)$ interactions $d-s$ and the interaction $s-p$. Then, since

$$M(ds) = F_0(ds) - G'_{ds}/2$$

and

$$M(ps) = F_0(ps) - G'_{ps}/2$$

we obtain, from (7)

$$M'(d^{n-1}sp) = A' + 7/18(n-1)(n-2)(C'-2B') + (2/3)(n-1)(11-n)\alpha' - (n-1)(G'_1 + 7/2G'_3 + G'_{ds}/2) - G'_{ps}/2. \quad (8)$$

Since for $d^{n-2}s^2p$ the interactions $d-s$ and $s-p$ are constant and can thus be incorporated into the height of the configuration, we have from (7)

$$M''(d^{n-2}s^2p) = A'' + (7/18)(n-2)(n-3)(C''-2B'') - (2/3)(n-2)(12-n)\alpha'' - (n-2)(G''_1 + 7/2G''_3) \quad (9)$$

Now, by using (1) for the final parameters of Ti I, we obtain from (8) and (9)

$$M'(d^2sp) = A' - 3{,}950$$

$M''(ds^2p) = A'' - 350$, as A'' incorporates $6\alpha''$.

Since the final values, before the uniform treatment (see ref. [6]) of A' and A'' for Ti I were

$$A' = 32{,}260 \text{ and } A'' = 40{,}240$$

then

$$D''(\mathrm{Ti}) = 11{,}580. \quad (11)$$

For Sc I, in the final results before the uniform treatment:

$$\begin{aligned} A' &= 24{,}920 \\ A'' &= 25{,}790 \\ G'_1 &= 330 \\ G'_3 &= 6 \\ G'_{ds} &= 1{,}930 \\ G'_{ps} &= 5{,}940. \end{aligned} \quad (12)$$

Then, since A' incorporates $6\alpha'$, we obtain from (8) and (9)

$$M'(dsp) = 20{,}634$$

$$M''(s^2p) = 25{,}790. \quad (13)$$

Thus,

$$D''(\mathrm{Sc}) = 5{,}156. \quad (14)$$

By assuming that D'' is a linear function of n, we would expect from (11) and (14)

$$D''(\mathrm{V}) = 18{,}000. \quad (15)$$

Now, from (8) and the values of the parameters in table 1

$$M'(d^3sp) = 37{,}780. \quad (16)$$

Then, from (15)

$$M''(d^2s^2p) = 55{,}780. \quad (17)$$

Assuming that the parameters of d^4p, d^3sp and d^2s^2p are in arithmetic progression, we finally obtain

$$A'' = 54{,}990. \quad (18)$$

Then, a new diagonalization was performed using the values of table 1 for the parameters of $d^4p + d^3sp$. The parameters pertaining to d^2s^2p had the following initial values:

$$\begin{aligned} A'' &= 54{,}990 \\ B'' &= 945 \\ C'' &= 3{,}072 \\ F''_2 &= 356 \\ G''_1 &= 311 \\ G''_3 &= 37 \\ \alpha'' &= 70 \\ J'(d^3sp - d^2s^2p) &= 1{,}088 \\ K'(d^3sp - d^2s^2p) &= 2{,}492 \\ H'(d^3sp - d^2s^2p) &= 172 \\ \zeta''_d = \zeta'_d = \zeta_d &= 146 \\ \zeta''_p = \zeta'_p = \zeta_p &= 124. \end{aligned} \quad (19)$$

A least-squares adjustment of the parameters was carried out in which A'' was fixed, the parameters, B, C, F_2, G_1, and G_3 were held in arithmetic progression, α, ζ_d, and ζ_p were made equal for the three configurations and the parameters H', J', K', and G were held equal to H, J, K, and G'_{ds}, respectively. The rms error was thus reduced from 345 to 249. In the least squares calculation of the next iteration, all levels inserted were below 43,000 cm^{-1}. Although all the experimental levels inserted into the least squares were assigned to the configurations $d^4p + d^3sp$, the eigenfunctions of some high levels inserted had contributions of up to 20 percent of d^2s^2p. Thus, a variation was attempted in which A″ was left to vary freely. The rms error was reduced from 236 to 231, with A'' assuming the very reasonable value of $54{,}424 \pm 741$.

In the least squares calculation of the final iteration of the uniform treatment 77 experimental terms splitting into 228 levels were inserted to yield an rms error

of only 216. Levels above 43,000 were not included, as many of them would show very high deviations if inserted into the least-squares. These high deviations are due to the fact that many of the terms above 43,000 either belong to, or are strongly perturbed by the configurations $(3d+4s)^4 5p$. In table 2, the experimental and calculated values of the levels and g-factors obtained from the least-squares calculation of the final iteration in the uniform treatment, are compared. The calculated values, percentage compositions and g-factors for all the 438 theoretically predicted levels are given. (The 45 levels assigned to $3d^2 4s^2 4p$ are included, since A'' was permitted to vary freely). Since G'_{ps} is much larger than G'_{ds} the $p-s$ interaction is stronger than the $d-s$ interaction. Consequently, the terms of d^3sp are coupled as $d^3(v_1S_1L_1)sp(^{1,3}\mathrm{P})SL$ and not $d^3s(S_2L_1)pSL$ as given in AEL.

The final values of the parameters in the uniform treatment (see ref. [6]) are given in table 1.

The main reasons for fixing $\zeta_d=\zeta'_d$ and $\zeta_p=\zeta'_p$ are that the fitted values of the parameters are reasonable, and only small differences occur between ζ_d and ζ'_d as well as ζ_p and ζ'_p, but *very* large standard errors are associated with them. In fact, the latter two parameters had standard errors larger than the actual parameter values. Furthermore, as the results are from a uniform treatment, consideration was also given to the results of keeping ζ'_p and ζ'_d free in Sc I and Ti I. There, the above mentioned effects are even more pronounced.

Below the cutoff height of 43,000 there are 243 odd experimental levels in AEL. The following 15 levels were rejected from the final least squares:

1. The level $z\,^4\mathrm{S}$ at 28621.
2. The two levels of $w\,^2\mathrm{G}$ at 36629 and 36828.
3. The four levels of $3d^3 4s(b\,^3\mathrm{H})p\ y^4\mathrm{H}$ at 37481, 37517, 37566, and 37626.
4. The level $x\,^2\mathrm{S}$ at 40300.
5. The level $w\,^2\mathrm{P}_{3/2}$ at 40694.
6. The two levels of $3d^3 4s(b\,^1\mathrm{G})4pu\,^2\mathrm{H}$ at 42079 and 42221.
7. The level 2° at 42237.
8. The three levels $w\,^6\mathrm{D}_{5/2,\,7/2,\,9/2}$ at 42480, 42587, and 42725.

3. Discussion

From the experimental results of Meggers and Russell [13], we note that the term $z\,^4\mathrm{S}$ is based only on combinations with the term $b\,^4\mathrm{P}$. Furthermore, as the lowest predicted term $^4\mathrm{S}$, i.e., $^2\mathrm{P}(^3\mathrm{P})^4\mathrm{S}$ is at 34065 and since for all the predicted levels in the neighborhood of 28,600 suitable experimental levels are known, the term $z\,^4\mathrm{S}$ was rejected.

In the range 33,500 to 38,500 two terms $^2\mathrm{G}$ are predicted. For the first term the main contribution is $(b\,^3\mathrm{F})^2\mathrm{G}$, whereas the second term is mostly $(^3\mathrm{H})^2\mathrm{G}$. However, in the narrower range of 36,600 to 37,300 there are the three experimental terms $d^4(b^3\mathrm{F})px^2\mathrm{G}$, $w\,^2\mathrm{G}$, and $d^4(a\,^3\mathrm{H})pv\,^2\mathrm{G}$. The experimental term $v\,^2\mathrm{G}$ was fitted to the theoretical term with the same assignment. The experimental term $x\,^2\mathrm{G}$ was then assigned to the other predicted term $^2\mathrm{G}$, since the experimental assignment $(b^3\mathrm{F})\,^2\mathrm{G}$ coincides with the major contribution of the predicted term, and also because $x\,^2\mathrm{G}$ is based on combinations with 7 even terms $a\,^2\mathrm{F}$, $a\,^2\mathrm{G}$, $b\,^2\mathrm{G}$, $a\,^2\mathrm{H}$, $b\,^2\mathrm{H}$, $a\,^4\mathrm{F}$, and $b\,^4\mathrm{F}$, whereas $w\,^2\mathrm{G}$ has combinations only with $a\,^2\mathrm{G}$ and $a\,^2\mathrm{H}$, [13]. Since there is no other predicted term to which the levels of $w\,^2\mathrm{G}$ could be assigned, $w\,^2\mathrm{G}$ was rejected.

In AEL, four experimental terms $z^4\mathrm{H}$, $y^4\mathrm{H}$, $x^4\mathrm{H}$, and $w\,^4\mathrm{H}$ are given, which should hopefully correspond to the four terms $^4\mathrm{H}$ which are predicted for the configurations $(d+s)^4\mathrm{p}$. Unfortunately, however, this correspondence is not feasible since the lowest predicted term $^4\mathrm{H}$, $^2\mathrm{G}(^3\mathrm{P})^4\mathrm{H}_{\mathrm{C.G.}}$ is at 29,750, whereas $z\,^4\mathrm{H}_{\mathrm{C.G.}}$ is at 32,856. In an earlier iteration, a variation was performed in which the four experimental terms $^4\mathrm{H}$ were assigned to the four theoretically predicted terms $^4\mathrm{H}$ with the same designations. Then, in the last-squares calculation the average deviations for the levels $^2\mathrm{G}(^3\mathrm{P})^4\mathrm{H}$ and $^2\mathrm{H}(^3\mathrm{P})^3\mathrm{H}$ were 2,269 and 3,244 respectively, and the rms error was 714. Subsequently, no experimental levels were assigned to $^2\mathrm{G}(^3\mathrm{P})^4\mathrm{H}$, the experimental levels $d^3s(b\,^3\mathrm{G})pz\,^4\mathrm{H}$ were assigned to $^2\mathrm{H}(^3\mathrm{P})^4\mathrm{H}$ and to the term $(^3\mathrm{G})^4\mathrm{H}$ was assigned the experimental term of the same designation. This left either $y\,^4\mathrm{H}$ or $x\,^4\mathrm{H}$ to assign to the theoretical term $(^3\mathrm{H})^4\mathrm{H}$. The term $x\,^4\mathrm{H}$ was chosen because:

1. it had the same designation as the theoretical term, whereas the designation of $y\,^4\mathrm{H}$ is given with a question mark in AEL,
2. the theoretical term $(^3\mathrm{H})^4\mathrm{H}$ is much closer to $x\,^4\mathrm{H}$ than to $y\,^4\mathrm{H}$,
3. the term $x^4\mathrm{H}$ is based on combinations with 5 even terms, whereas $y\,^4\mathrm{H}$ has combinations with 3 even terms.

Since there are no other terms of $(3d+4s)^4 4p$ to which the levels of $y^4\mathrm{H}$ could conceivably be assigned they were rejected.

In the range 36,000 to 43,000, suitable experimental levels correspond to *all* the predicted levels. The term $x\,^2\mathrm{S}$ is based only on three weak combinations [13], and so it was rejected.

To the theoretical term at 40,000, whose major contribution is $^2\mathrm{P}(^3\mathrm{P})^2\mathrm{P}$, is assigned the term $x\,^2\mathrm{P}$ rather than $w\,^2\mathrm{P}$ as for the former term both experimental levels are given, whereas the level $w\,^2\mathrm{P}_{1/2}$ is missing. It should be noted also that the deviation for $x\,^2\mathrm{P}_{3/2}$ is smaller by about 250 cm^{-1} than if $w\,^2\mathrm{P}_{3/2}$ were inserted.

Below 44,000 cm^{-1}, there are 5 predicted terms $^2\mathrm{H}$ to which the experimental terms $z\,^2\mathrm{H}$, $y\,^2\mathrm{H}$, $x\,^2\mathrm{H}$, $w\,^2\mathrm{H}$, and $v\,^2\mathrm{H}$ correspond. Although the levels of $u\,^2\mathrm{H}$ are based on 11 combinations with the 5 even terms $a\,^4\mathrm{F}$, $a\,^2\mathrm{G}$, $a\,^2\mathrm{H}$, $b\,^2\mathrm{H}$, and $b\,^2\mathrm{G}$ [13], this term is superfluous for $(3d+4s)^4 4p$ (it should be noted that it is not possible to reject $v\,^2\mathrm{H}$ and retain $u\,^2\mathrm{H}$, since the former is based upon more combinations with even terms than the latter, [13]).

From table 2, it is evident that there is no theoretical level of $(3d+4s)^44p$ to which the experimental level $2°$ at 42,237 could be assigned.

The three levels $w\,^6D_{5/2,\,7/2,\,9/2}$ most probably should be assigned to $^4F(^3P)5pw\,^6D$.

The following changes in designation were performed:

1. AEL $z\,^2S_{1/2} \longrightarrow {}^2P(^3P)^4P_{1/2}$
2. AEL $d^3s(b\,^3G)pz\,^4H \longrightarrow {}^2H(^3P)z\,^4H$
3. $^2P(^3P)^2D \longleftrightarrow A^2D(^3P)^4F_{3/2,\,5/2}$
4. $(A^3P)^4S \longleftrightarrow {}^4P(^3P)^4S$
5. AEL $d^4(a\,^3P)px\,^4P \longrightarrow A^2D(^3P)x\,^4P$
6. AEL $d^4(b\,^3F)pw\,^2F \longleftrightarrow A^2D(^3P)w\,^2F$
7. $(A^3P)\,^4D \longleftrightarrow (A^3F)\,^4D$
8. AEL $d^3s(a\,^5P)pw\,^4P \longrightarrow (A^3P)w\,^4P$
9. $A\,^2D(^3P)u\,^2D_{5/2} \longleftrightarrow (^3G)v\,^2F_{5/2}$
10. AEL $d^3s(b\,^1G)pt\,^2G \longrightarrow (A^3F)t\,^2G$
11. AEL $d^3s(a\,^1H)pv\,^2H \longrightarrow {}^2G(^1P)v\,^2H$
12. AEL $d^3s(b\,^1D)pu\,^2F \longrightarrow (^3D)u\,^2F$
13. AEL $d^3s(a\,^1P)pv\,^2P \longrightarrow (^3D)v\,^2P$

The lowest theoretically predicted term ^2S is at 32,342. Thus, only one of the two experimental terms $z\,^2S$ or $y\,^2S$ can be assigned to it. The term $y\,^2S$ was chosen because:

1. its deviation is smaller by about 170 than if $z\,^2S$ were chosen,
2. the combinations of $y\,^2S$ are only with doublets, whereas $z\,^2S$ is based on combinations also with $a\,^4D$ and $a\,^6D$,
3. the experimental g-factor of $y\,^2S$ fits better to the theoretical g-factor of the lowest predicted term ^2S.

In the range 31,000 to 33,000 there is now left vacant the theoretical term ^4P whose main contribution is $^2P(^3P)^4P$, and the sole unassigned term is $z\,^2S$. Since $z\,^2S$ is based on combinations with $a\,^2P$, $b\,^2P$, $a\,^4D$, and $a\,^6D$, and since it fits quite well in value and g-factor to the theoretical level $^2P(^3P)^4P_{1/2}$, we performed the first change above.

The reasons for changing the assignment of $z\,^4H$ were considered previously.

As mentioned already by Meggers and Russell [13], the configuration assignments of many odd doublets and quartets are doubtful. The exchanges 4–8 and 10–12 illustrate this point, as in all cases the contributions in the eigenfunctions of the experimental assignments are very small.

By means of the exchange 9, the calculated splittings of the terms $v\,^2F$ and $u\,^2D$ correspond more closely to the experimental splittings for these two terms.

With regard to the change 13, it should be noted that there is strong mixing between the eigenfunctions of the terms $(^3D)^2P$ and $^2P(^3P)^2P$.

Although the number of changes in assignment performed is not as large as may be expected on the basis of the complexity of this spectrum and the difficulties involved in determining the configuration assignments prior to a theoretical investigation, below 43,000 there are *22* experimental terms in AEL without configuration designations. Of these, the terms $z\,^2S$, $w\,^2G$, and $w\,^2P$ were rejected, whereas for the other 19 terms the calculated configuration assignments are specified in table 2.

The level 1^0 has combinations with $a\,^4P$, $a\,^4D$, $b\,^4D$, $a\,^4F$, and $f\,^6P$ with J equal to 1/2, 3/2, and 5/2. The theoretical terms $^2P(^3P)^4S$ and $^2P(^3P)^2S$ are predicted at around 34,000 and neither term has as yet any assigned corresponding experimental term. Since the deviation obtained on fitting the level 1^0 to $^2P(^3P)^4S$ is only -46 (for $^2P(^3P)^2S$ it would be about -450) and since the level 1^0 has combinations with even levels of J equal to 5/2 and the sextet $f\,^6P$, we assigned it to the theoretical term $^2P(^3P)^4S$.

Below 43,000 cm^{-1} the following theoretical terms had no experimental counterparts:

1.	$^2G(^3P)^4H$	29,583 − 29,942
2.	$^2P(^3P)^4P$	31,467 − 31,669
3.	$^2P(^3P)^2S$	34,476
4.	$^2H(^3P)^4I$	34,950 − 35,223
5.	$A^2D(^3P)^2P + {}^2P(^3P)^2P$	35,484 − 35,749.

Most of the experimental and calculated g-factors correspond quite closely. However, there are some exceptions due to unsuitably calculated eigenvectors. For example, the experimental g-factor of $u\,^4F_{3/2}$ is 0.54. However, as the theoretical eigenfunction contains 13 percent of ^4S with g-factor of 2.00, the calculated g-factor is 0.803. Similarly, the experimental g-factor of $x\,^4S$ is 2.00, but as the theoretical eigenfunction contains contributions of $^2D_{3/2}$ and $^4D_{3/2}$ with g-factors of 0.800 and 1.200, respectively, the calculated g-factor of $x\,^4S$ is 1.539. On the other hand, since the theoretical g-factors for $^2S_{1/2}$ and $^2P_{1/2}$ are 2.000 and 0.667 respectively, and the experimental g-factors for $w\,^2S_{1/2}$ and $w\,^2P_{1/2}$ are 1.50 and 1.14, it is evident that the experimental mixing between these two levels is very strong. However, the theoretical eigenfunctions are almost pure ^2S and ^2P and hence the calculated g-factors are 2.020 and 0.672, respectively.

4. Table Entries

In the column "NAME" the calculated designation of the term is given. Whenever the terms of the parent d^n have different seniorities these are denoted by the letters A and B, the lower calculated term being designated by A. Whenever a calculated term has a corresponding experimental term the small letters z,y,x . . . are used as in AEL. The terms of d^3sp are denoted by $d^3v_1S_1L_1(sp^{1,3}P)SL$. The terms of d^4p are differentiated from those of d^2s^2p by using a star for the latter terms.

The entries in the columns "J", "OBS. LEVEL cm^{-1}", "CALC. LEVEL cm^{-1}" "OBS. g-FACT." and "CALC. g-FACT." are self evident. In the column "PERCENTAGE" for each calculated level either the three highest contributions or all those contributions exceeding 5 percent are given.

Whenever the experimental and calculated term designations differ, the experimental designation is entered in the column "AEL", using the notation of C. E. Moore [8]. In many instances the exchanges involve complete terms rather than isolated levels. Unless specified otherwise the entries in the column "AEL" pertain to exchanges in terms.

The column "O−C" gives the difference between the observed and calculated values of the levels.

The entries are in the order of increasing energy of the calculated terms.

The work described in this paper was supported in part by the National Bureau of Standards, Washington, D.C.

TABLE 2. *Observed and calculated levels of* V I $(3d+4s)^4 4p$

Name	J	Percentage	AEL		Obs. level (cm^{-1})	Calc. level (cm^{-1})	O−C	Obs. g-factor	Calc. g-factor
			Config.	Desig.					
$^4F(^3P)\,^6G$	3/2	100	$3d^34s(a\,^5F)4p$	$z\,^6G$	16,361	16,354	7	0.00	0.000
	5/2	100			16,450	16,426	24	0.78	0.857
	7/2	100			16,573	16,527	46	1.10	1.143
	9/2	100			16,729	16,655	74	1.22	1.273
	11/2	100			16,917	16,810	107	1.26	1.343
	13/2	100			17,136	16,992	144	1.43	1.385
$^4F(^3P)\,^6D$	1/2	$90+8\ (^5D)\,^6D$	$3d^34s(a\,^5F)4p$	$z\,^6D$	18,086	18,075	11	3.20	3.331
	3/2	$89+8\ (^5D)\,^6D$			18,126	18,117	9	1.76	1.865
	5/2	$89+8\ (^5D)\,^6D$			18,198	18,187	11	1.58	1.656
	7/2	$89+8\ (^5D)\,^6D$			18,302	18,287	15	1.56	1.586
	9/2	$89+8\ (^5D)\,^6D$			18,438	18,417	21	1.55	1.555
$^4F(^3P)\,^6F$	1/2	95	$3d^34s(a\,^5F)4p$	$z\,^6F$	18,120	18,174	−54	−0.44	−0.665
	3/2	95			18,174	18,218	−44	1.14	1.068
	5/2	95			18,259	18,291	−32	1.28	1.315
	7/2	95			18,372	18,392	−20	1.28	1.398
	9/2	95			18,513	18,519	−6	1.38	1.435
	11/2	96			18,680	18,673	7	1.42	1.454
$^4F(^3P)\,^4D$	1/2	90	$3d^34s(a\,^3F)4p$	$z\,^4D$	20,606	20,649	−43	−0.04	0.000
	3/2	90			20,688	20,723	−35	1.21	1.200
	5/2	90			20,828	20,850	−22	1.35	1.371
	7/2	90			21,033	21,032	1	1.45	1.429
$^4F(^3P)\,^4G$	5/2	93	$3d^34s(a\,^3F)4p$	$z\,^4G$	21,841	21,948	−107	0.55	0.572
	7/2	93			21,964	22,049	−85	0.96	0.984
	9/2	93			22,121	22,180	−59	1.16	1.172
	11/2	93			22,314	22,342	−28	1.24	1.273
$^4F(^3P)^4F$	3/2	94	$3d^34s(a\,^3F)4p$	$z\,^4F$	23,088	23,118	−30	0.39?	0.404
	5/2	94			23,211	23,209	2	0.98?	1.029
	7/2	95			23,353	23,328	25	1.23	1.238
	9/2	95			23,520	23,476	44	1.31	1.333
$^4F(^3P)^2D$	3/2	89	$3d^34s(a\,^3F)4p$	$z\,^2D$	23,609	23,997	−388	0.76	0.796
	5/2	89			23,935	24,285	−350	1.32?	1.200
$(^5D)^6P$	3/2	$71+29\,^4P(^3P)^6P$			24,648	24,611	37	2.34	2.398
	5/2	$71+29\,^4P(^3P)^6P$			24,728	24,683	45	1.85	1.884
	7/2	$71+29\,^4P(^3P)^6P$			24,839	24,783	56	1.67	1.714
$(^5D)^6F$	1/2	95			24,789	24,725	64	−0.58	−0.662
	3/2	95			24,830	24,770	60	1.02	1.067
	5/2	95			24,899	24,844	55	1.23	1.314
	7/2	96			24,993	24,947	46	1.37	1.397
	9/2	96			25,112	25,076	36	1.41	1.434
	11/2	96			25,254	25,331	23	1.41	1.454

TABLE 2. *Observed and calculated levels of* V I $(3d+4s)^4 4p$ – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
$(^5D)^4P$	1/2	89			24,771	25,067	−296	2.54	2.669
	3/2	89			24,915	25,206	−291	1.71	1.733
	5/2	89			25,131	25,424	−293	1.59	1.599
$^4F(^3P)^2G$	7/2	93	$3d^34s(a\,^3F)4p$	$z\,^2G$	26,022	25,954	68	0.92	0.891
	9/2	90			26,345	26,165	180	1.13	1.121
$(^5D)^4D$	1/2	$65+30\,^4F(^1P)^4D$			26,183	26,013	170	−0.06	0.000
	3/2	$65+29\,^4F(^1P)^4D$			26,249	26,073	176	1.17	1.196
	5/2	$65+28\,^4F(^1P)^4D$			26,353	26,167	186	1.34	1.364
	7/2	$63+27\,^4F(^1P)^4D$			26,480	26,281	199	1.39	1.419
$(^5D)^4F$	3/2	$76+17\,^4F(^1P)^4F$			25,931	26,179	−248	0.42	0.412
	5/2	$73+16\,^4F(^1P)^4F$			26,004	26,245	−241	0.98	1.051
	7/2	$67+15\,^4F(^1P)^4F$			26,122	26,328	−206	1.15	1.269
	9/2	$64+14\,^4F(^1P)^4F+11(^5D)^6D$			26,172	26,420	−248	1.23	1.353
$(^5D)^6D$	1/2	$82+10\,^4F(^3P)^6D$			26,397	26,327	70	3.25	3.326
	3/2	$82+10\,^4F(^3P)^6D$			26,438	26,367	71	1.86	1.860
	5/2	$81+10\,^4F(^3P)^6D$			26,506	26,437	69	1.59	1.643
	7/2	$78+10\,^4F(^3P)^6D$			26,605	26,545	60	1.58	1.564
	9/2	$72+10(^5D)^4F+9\,^4F(^3P)^6D$			26,738	26,697	41	1.50	1.526
$^4F(^3P)^2F$	5/2	97	$3d^34s(a\,^3F)4p$	$z\,^2F$	27,188	27,100	88	1.01?	0.857
	7/2	97			27,471	27,345	126	1.01	1.143
$^4P(^3P)^6D$	1/2	91	$3d^34s(a\,^5P)4p$	$x\,^6D$	28,314	28,327	−13	3.23	3.330
	3/2	91			28,369	28,369	0	1.82	1.866
	5/2	91			28,462	28,440	22	1.58	1.657
	7/2	91			28,596	28,542	54	1.52	1.587
	9/2	91			28,768	28,676	92	1.47	1.555
$^4P(^3P)^6P$	3/2	$71+29(^5D)^6P$	$3d^34s(a\,^5P)4p$	$y\,^6P$	29,203	29,009	194	2.32	2.399
	5/2	$71+29(^5D)^6P$			29,296	29,086	210	1.76	1.885
	7/2	$71+29(^5D)^6P$			29,418	29,185	233	1.62	1.714
$^2G(^3P)^4H$	7/2	$87+10\,^2H(^3P)^4H$				29,583			0.667
	9/2	$87+10\,^2H(^3P)^4H$				29,677			0.970
	11/2	$87+10\,^2H(^3P)^4H$				29,796			1.133
	13/2	$88+10\,^2H(^3P)^4H$				29,942			1.231
$^4P(^3P)^4P$	1/2	$80+9A\,^2D(^3P)^4P$	$3d^34s(c\,^3P)4p$	$y\,^4P$	30,022	30,095	−73	2.67	2.664
	3/2	$82+8A\,^2D(^3P)^4P$			30,095	30,148	−53	1.74	1.733
	5/2	$83+7A\,^2D(^3P)^4P$			30,121	30,172	−51	1.67	1.605
$^2G(^3P)^4G$	5/2	$65+30\,^4F(^1P)^4G$	$3d^34s(b\,^3G)4p$	$y\,^4G$	30,636	30,453	183	0.53	0.572
	7/2	$68+27\,^4F(^1P)^4G$			30,694	30,528	166	0.93	0.984
	9/2	$70+25\,^4F(^1P)^4G$			30,772	30,622	150	1.13	1.171
	11/2	$73+22\,^4F(^1P)^4G$			30,864	30,732	132	1.21	1.272
$^4P(^3P)^6S$	5/2	96	$3d^34s(a\,^5P)4p$	$z\,^6S$	30,833	31,018	−185		1.985
$^2G(^3P)^4F$	3/2	$79+7A\,^2D(^3P)^4F$	$3d^34s(b\,^3G)4p$	$x\,^4F$	31,200	31,393	−193	0.38	0.401
	5/2	$80+7A\,^2D(^3P)^4F$			31,229	31,412	−183	1.01	1.029
	7/2	$80+6A\,^2D(^3P)^4F$			31,268	31,441	−173	1.21	1.238
	9/2	$81+6A\,^2D(^3P)^4F$			31,318	31,481	−163	1.32	1.333

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
$^2P(^3P)^4P$	1/2	$63+10A^2D(^3P)^4P$		$z\,^2S$	31,786	31,385	401	2.30	2.661
	3/2	$62+11A^2D(^3P)^4P$				31,467			1.731
	5/2	$61+13A^2D(^3P)^4P$				31,669			1.607
$^4F(^1P)^4G$	5/2	$62+23^2G(^3P)^4G$	$3d^34s(a\,^5F)4p$	$x\,^4G$	31,398	31,518	−120	0.53	0.572
	7/2	$64+20^2G(^3P)^4G$			31,541	31,616	−75	0.95	0.984
	9/2	$66+18^2G(^3P)^4G$			31,722	31,743	−21	1.12	1.171
	11/2	$69+15^2G(^3P)^4G$			31,937	31,902	35	1.20	1.272
$^2P(^3P)^4D$	1/2	$56+16^4P(^3P)^4D$		$x\,^4D$	32,349	32,093	256	0.08	0.003
	3/2	$58+16^4P(^3P)^4D$			32,456	32,191	265	1.17	1.200
	5/2	$59+14^4P(^3P)^4D$			32,660	32,340	320	1.29	1.370
	7/2	$60+12^4P(^3P)^4D$			32,891	32,523	368	1.35	1.427
$(A^3P)^2S$	1/2	$33+34^2P(^3P)^2S+10^4P(^3P)^2P$		$y\,^2S$	31,962	32,342	−380	2.21	1.734
$^4F(^1P)^4F$	3/2	$61+20(^5D)^4F$	$3d^34s(a\,^5F)4p$	$w\,^4F$	32,738	32,587	151	0.52	0.402
	5/2	$61+19(^5D)^4F$			32,847	32,679	168	1.01	1.029
	7/2	$61+19(^5D)^4F$			32,989	32,805	184	1.18	1.238
	9/2	$61+19(^5D)^4F$			33,155	32,963	192	1.30	1.333
$^2H(^3P)^4H$	7/2	$62+22(^3H)^4H$	$3d^34s(b\,^3G)4p$	$z\,^4H$	32,692	32,739	−47	0.68	0.689
	9/2	$64+23(^3H)^4H$			32,788	32,818	−30	0.98	0.980
	11/2	$68+25(^3H)^4H$			32,898	32,908	−10	1.11	1.133
	13/2	$69+25(^3H)^4H$			32,964	32,965	−1	1.21	1.231
$^4P(^3P)^2P$	1/2	$53+15(A^3P)^2P+8^2P(^3P)^2S$		$z\,^2P$	32,725	32,828	−103	0.73?	0.899
	3/2	$64+18(A^3P)^2P$			32,768	32,824	−56	1.22	1.329
$^2G(^3P)^2G$	7/2	$81+6^2H(^3P)^4H$		$y\,^2G$	33,360	33,377	−17	0.91	0.871
	9/2	$84+5^2H(^3P)^4H$			33,307	33,307	0	1.03	1.099
$^2G(^3P)^2H$	9/2	$85+8^2H(^3P)^2H$		$z\,^2H$	33,640	33,546	94	0.92	0.910
	11/2	$87+8^2H(^3P)^2H$			33,695	33,588	107	1.09	1.090
$^2G(^3P)^2F$	5/2	$79+8A^2D(^3P)^2F$		$y\,^2F$	33,538	33,758	−230	0.85	0.864
	7/2	$76+8A^2D(^3P)^2F$			33,481	33,698	−217	1.11	1.152
$^4P(^3P)^4D$	1/2	$68+14^2P(^3P)^4D$	$3d^34s(c\,^3P)4p$	$w\,^4D$	33,967	33,946	21	0.09	0.003
	3/2	$57+12^2P(^3P)^4D$			33,976	33,923	53	0.80	1.136
	5/2	$63+13^2P(^3P)^4D$			34,066	33,935	131	1.30	1.353
	7/2	$68+12^2P(^3P)^4D$			34,128	33,965	163	1.35	1.416
$^2P(^3P)^4S$	3/2	$70+6^4P(^3P)^4S$		1^0	34,019	34,065	−46		1.802
$^2P(^3P)^2D$	3/2	$26+16A^2D(^3P)^2D$ $+16A^2D(^3P)^4F$		$v\,^4F$	34,030	34,060	−30	0.86	0.965
	5/2	$38+24A^2D(^3P)^2D$ $+14A^2D(^3P)^4F$		$v\,^4F$	34,168	34,189	−21	1.32?	1.179
$^2P(^3P)^2S$	1/2	$64+25(A^3P)^2S$				34,476			1.985
$A^2D(^3P)^4F$	3/2	$62+8^2P(^3P)^2D$		$y\,^2D$	34,429	34,480	−51	0.73	0.507
	5/2	$66+7^2P(^3P)^2D+7(^3G)^4F$		$y\,^2D$	34,487	34,509	−22	1.18	1.066
	7/2	$81+9(^3G)^4F$		$v\,^4F$	34,375	34,547	−172	1.21	1.241
	9/2	$82+9(^3G)^4F$			34,530	34,668	−138	1.41	1.333
$^4F(^1P)^4D$	1/2	$24+18(A^3P)^4D+16^2P(^3P)^4D$	$3d^34s(a\,^5F)4p$	$v\,^4D$	34,477	34,710	−233	0.00	0.004
	3/2	$25+16(A^3P)^4D+16^2P(^3P)^4D$			34,537	34,785	−248	1.05	1.197
	5/2	$27+17(A^3P)^4D+15^2P(^3P)^4D$			34,620	34,911	−291	1.28	1.369
	7/2	$28+15(A^3P)^4D+15^2P(^3P)^4D$			34,747	35,082	−335	1.35	1.427

TABLE 2. *Observed and calculated levels of* V I (3d + 4s)^{4}4p – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
^{2}H(^{3}P)^{4}I	9/2	98				34,950			0.730
	11/2	99				35,019			0.966
	13/2	100				35,109			1.108
	15/2	100				35,223			1.200
A^{2}D(^{3}P)^{4}D	1/2	58 + 16^{4}F(^{1}P)^{4}D		$u\,^4$D	35,013	35,120	−107		0.022
	3/2	58 + 15^{4}F(^{1}P)^{4}D			35,092	35,172	−80	1.12	1.208
	5/2	63 + 16^{4}F(^{1}P)^{4}D			35,225	35,283	−58	1.32	1.371
	7/2	67 + 16^{4}F(^{1}P)^{4}D			35,379	35,399	−20	1.33	1.428
A^{2}D(^{3}P)^{2}P	1/2	40 + 34^{2}P(^{3}P)^{2}P				35,749			0.662
	3/2	41 + 34^{2}P(^{3}P)^{2}P				35,484			1.328
(^{3}G)^{2}G	7/2	13 + 21(A^{3}F)^{2}G + 13^{2}G(^{3}P)^{2}G	$3d^4(b\,^3$F$)4p$	$x\,^2$G	36,461	36,656	−195	0.85	1.001
	9/2	19 + 31(A^{3}F)^{2}G + 19^{2}G(^{3}P)^{2}G			36,539	36,728	−189	1.05	1.103
(A^{3}F)^{2}F	5/2	26 + 25^{2}G(^{3}P)^{2}F + 22A^{2}D(^{3}P)^{2}F		$x\,^2$F	36,766	36,656	110	0.89	0.857
	7/2	24 + 22^{2}G(^{3}P)^{2}F + 19A^{2}D(^{3}P)^{2}F			36,926	36,822	104	1.05	1.001
^{4}P(^{3}P)^{2}D	3/2	38 + 17(A^{3}P)^{2}D + 14(A^{3}F)^{2}D		$x\,^2$D	36,416	36,769	−353	0.89	0.867
	5/2	36 + 14(A^{3}P)^{2}D + 13(A^{3}F)^{2}D			36,701	36,818	−117	1.13	1.237
^{2}H(^{3}P)^{4}G	5/2	42 + 19(A^{3}F)^{4}G + 14(^{3}G)^{4}G	$3d^34s(b\,^3$H$)4p$	$w\,^4$G	36,763	36,752	11		0.619
	7/2	27 + 11(A^{3}F)^{4}G + 8(^{3}G)^{4}G			36,823	36,749	74	1.06	1.003
	9/2	46 + 14(A^{3}F)^{4}G + 13(^{3}G)^{4}G			36,898	36,830	68	1.17	1.160
	11/2	54 + 15(A^{3}F)^{4}G + 15(^{3}G)^{4}G			36,938	36,867	71	1.26	1.272
A^{2}D(^{3}P)^{4}P	1/2	69 + 18^{2}P(^{3}P)^{4}P	$3d^4(a\,^3$P$)4p$	$x\,^4$P	36,695	36,862	−167	2.51	2.629
	3/2	44 + 24^{4}P(^{3}P)^{4}S + 11^{2}P(^{3}P)^{4}P			36,815	36,689	126	1.77	1.800
	5/2	59 + 15^{2}P(^{3}P)^{4}P			36,612	36,773	−161	1.54	1.513
(A^{3}P)^{2}P	1/2	31(A^{3}P)^{2}P + 32A^{2}D(^{3}P)^{2}P			36,478	36,888	−410	0.74	0.683
	3/2	29(A^{3}P)^{2}P + 31A^{2}D(^{3}P)^{2}P			36,580	37,090	−510	1.17	1.313
^{2}H(^{3}P)^{2}H	9/2	67 + 9(^{3}H)^{2}H		$y\,^2$H	37,181	36,936	245	0.73	0.925
	11/2	74 + 10(^{3}H)^{2}H			37,211	36,888	323	1.08	1.090
^{4}P(^{3}P)^{4}S	3/2	41 + 25A^{2}D(^{3}P)^{4}P	$3d^4(a\,^3$P$)4p$	$y\,^4$S	36,408	36,966	−558	1.85	1.881
(^{3}H)^{2}G	7/2	60 + 11^{2}H(^{3}P)^{2}G		$v\,^2$G	37,175	37,088	87	0.99	0.915
	9/2	52 + 20(^{3}H)^{4}I + 11^{2}H(^{3}P)^{2}G			37,362	37,223	139	1.05	1.031
(^{3}H)^{4}I	9/2	76 + 14(^{3}H)^{2}G			37,285	37,124	161	0.87	0.814
	11/2	98			37,316	37,192	124	0.96	0.969
	13/2	99			37,404	37,301	103	1.08	1.109
	15/2	100			37,518	37,431	87	1.15	1.200
(A^{3}P)^{4}D	1/2	46 + 14^{4}F(^{1}P)^{4}D	$3d^4(b\,^3$F$)4p$	$t\,^4$D	37,757	37,298	459	0.01	0.017
	3/2	46 + 14^{4}F(^{1}P)^{4}D			37,835	37,386	449	1.18	1.198
	5/2	45 + 13^{4}F(^{1}P)^{4}D			37,960	37,532	428	1.33	1.368
	7/2	44 + 15^{4}F(^{1}P)^{4}D			38,116	37,734	382	1.35	1.425
A^{2}D(^{3}P)^{2}F	5/2	34 + 16(A^{3}F)^{2}F + 13^{2}G(^{3}P)^{2}F	$3d^4(b\,^3$F$)4p$	$w\,^2$F	37,343	37,532	−189	0.84	0.863
	7/2	37 + 20(A^{3}F)^{2}F + 13^{2}G(^{3}P)^{2}F			37,475	37,632	−157	1.08	1.129
(A^{3}F)^{2}D	3/2	30 + 27^{4}P(^{3}P)^{2}D + 22^{2}P(^{3}P)^{2}D			37,458	37,502	−44	0.80	0.804
	5/2	35 + 26^{4}P(^{3}P)^{2}D + 23^{2}P(^{3}P)^{2}D			37,753	37,744	9	1.18	1.197
(^{3}H)^{2}I	11/2	45 + 44^{2}H(^{3}P)^{2}I			37,530	37,730	−200	0.94	0.927
	13/2	42 + 46^{2}H(^{3}P)^{2}I			37,606	37,787	−181	1.06	1.077

TABLE 2. *Observed and calculated levels of* V I $(3d+4s)^4 4p$ – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
$(A^3F)^4G$	5/2	$62+30\,^2H(^3P)^4G$			37,499	37,801	−302	0.60	0.574
	7/2	$57+26\,^2H(^3P)^4G$			37,556	37,831	−275	1.02	0.957
	9/2	$57+24\,^2H(^3P)^4G$			37,644	37,894	−250	1.15	1.147
	11/2	$58+23\,^2H(^3P)^4G$			37,765	37,995	−230	1.22	1.254
$(^3H)^4H$	7/2	$46+27(^3G)^4H+13\,^2H(^3P)^4H$			38,246	38,064	182	0.67	0.696
	9/2	$43+24(^3G)^4H+12\,^2H(^3P)^4H$			38,324	38,144	180	0.93	0.988
	11/2	$45+23(^3G)^4H+12\,^2H(^3P)^4H$			38,405	38,229	176	1.11	1.140
	13/2	$52+27(^3G)^4H+14\,^2H(^3P)^4H$			38,483	38,311	172	1.22	1.229
$(^3H)^2H$	9/2	$55+17\,^2H(^3P)^2H$			38,124	38,213	−89	0.88	0.914
	11/2	$54+18\,^2H(^3P)^2H$			38,221	38,299	−78	1.10	1.095
$^2H(^3P)^2G$	7/2	$78+9\,^2F(^3P)^2G$		$u\,^2G$	38,611	38,676	−65	0.88?	0.890
	9/2	$78+9\,^2F(^3P)^2G$			38,530	38,618	−88	0.99	1.111
$^2H(^3P)^2I$	11/2	$53+46(^3H)^2I$			39,009	38,687	322	0.92	0.924
	13/2	$50+49(^3H)^2I$			39,081	38,748	333	1.06	1.078
$(A^3P)^4S$	3/2	$40+14(A^3P)^4P+13\,^4P(^3P)^4S$	$3d^34s(c\,^3P)4p$	$x\,^4S$	39,847	39,279	568	2.00	1.539
$(A^3F)^4F$	3/2	$47+13(A^3P)^4S$			39,267	39,280	−13	0.54	0.803
	5/2	$67+9\,^2F(^3P)^4F$			39,300	39,329	−29	1.00	1.027
	7/2	$66+9\,^2F(^3P)^4F$			39,342	39,357	−15	1.21	1.234
	9/2	$66+9\,^2F(^3P)^4F$			39,391	39,389	2	1.30	1.330
$(A^3P)^4P$	1/2	$72+16\,^2P(^3P)^4P$	$3d^34s(a\,^5P)4p$	$w\,^4P$	39,237	39,413	−176	2.57	2.655
	3/2	$43+16(A^3P)^4S+9\,^2P(^3P)^4P$			39,249	39,625	−376	1.60	1.615
	5/2	$52+11\,^2P(^3P)^4P$			39,423	39,605	−182	1.52	1.496
$(A^3P)^2D$	3/2	$40+17(A^3F)^2D$			39,884	39,556	328	0.92	0.987
	5/2	$40+16(A^3F)^2D$			40,119	39,934	185	1.14	1.155
$A^2D(^3P)^2D$	3/2	$37+21\,^2P(^3P)^2D$	$3d^34s(a\,^1P)4p$	$u\,^2D$	40,225	39,957	268	0.70	0.967
	5/2	$43+27\,^2P(^3P)^2D$		$v\,^2F$	40,154	39,849	305		1.276
$^2P(^3P)^2P$	1/2	$51+21A^2D(^3P)^2P$		$x\,^2P$	40,329	39,893	436		0.673
	3/2	$35+14A^2D(^3P)^2P+13A^2D(^3P)^2D$			40,437	40,076	361	1.52	1.167
$(^3H)^4G$	5/2	$32+21(^3G)^4G+9\,^2H(^3P)^4G$			39,962	39,999	−37	0.53	0.686
	7/2	$38+25(^3G)^4G+11\,^2H(^3P)^4G$			40,001	40,031	−30	0.99	0.995
	9/2	$42+27(^3G)^4G+12\,^2H(^3P)^4G$			40,039	40,064	−25	1.19	1.170
	11/2	$42+28(^3G)^4G+13\,^2H(^3P)^4G$			42,064	40,070	−6	1.23	1.270
$(A^3F)^4D$	1/2	$63+18(A^3P)^4D$	$3d^4(a\,^3P)4p$	$s\,^4D$	39,878	40,066	−188	0.01	0.011
	3/2	$59+18(A^3P)^4D$			39,935	40,111	−176	1.10	1.189
	5/2	$46+16(A^3P)^4D$			40,000	40,190	−190	1.33	1.277
	7/2	$44+18(A^3P)^4D$			40,126	40,228	−102	1.38	1.330
$(^3G)^2F$	5/2	$40+12(A^3F)^4D+12A^2D(^3P)^2F$	$3d^34s(a\,^1P)4p$	$u\,^2D$	40,326	40,250	76	1.12	0.912
	7/2	$44+14(A^3F)^4D+13A^2D(^3P)^2F$		$v\,^2F$	40,587	40,286	301	1.01	1.183
$(^3G)^4H$	7/2	$59+22(^3H)^4H+7\,^2H(^3P)^4H$			40,315	40,270	45	0.65	0.718
	9/2	$66+24(^3H)^4H+8\,^2H(^3P)^4H$			40,379	40,328	51	0.92	0.974
	11/2	$67+23(^3H)^4H+8\,^2H(^3P)^4H$			40,452	40,411	41	1.08	1.134
	13/2	$70+23(^3H)^4H+7\,^2H(^3P)^4H$			40,536	40,508	28	1.22	1.230
$(A^3F)^2G$	7/2	$44+30(^3G)^2G$	$3d^34s(b\,^1G)4p$	$t\,^2G$	41,437	41,043	394	0.90	0.890
	9/2	$42+30(^3G)^2G$			41,539	41,137	402	1.04	1.106

TABLE 2. *Observed and calculated levels of* V I $(3d+4s)^4 4p$ – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
$(^3G)^2H$	9/2	$66+11^2G(^3P)^2H$		$w\,^2H$	40,981	41,232	−251	0.99	0.914
	11/2	$71+10^2G(^3P)^2H$			40.920	41,199	−279	0.96?	1.092
$(^3D)^2F$	5/2	$41+19(A^3F)^2F+12(^3F)^2F^*$	$3d^34s(b\,^1D)4p$	$u\,^2F$	41,950	41,479	471	0.84	0.858
	7/2	$43+13(A^3F)^2F+11(^3F)^2F^*$			42,021	41,526	495	1.11	1.143
$^2G(^1P)^2H$	9/2	$43+28(^1I)^2H$	$3d^34s(a\,^1H)4p$	$v\,^2H$	41,501	41,653	−152	0.87	0.916
	11/2	$42+30(^1I)^2H$			41,660	41,750	−90	1.05	1.095
$(^3G)^4F$	3/2	$47+20(^3D)^4F$			41,389	41,828	−439	0.42	0.406
	5/2	$25+27(^3G)^4G+14(^3D)^4F$			41,429	41,705	−276	0.89?	0.810
	7/2	$26+26(^3G)^4G+13(^3D)^4F$			41,492	41,736	−244	1.15	1.121
	9/2	$27+23(^3G)^4G+12(^3D)^4F$			41,599	41,817	−217	1.23	1.260
$(^3D)^2P$	1/2	$36+28^2P(^3P)^2P$	$3d^34s(a\,^1P)4p$	$v\,^2P$	42,481	41,863	618	1.14	0.672
	3/2	$35+30^2P(^3P)^2P$			42,318	41,783	535	1.34	1.344
$(^3G)^4G$	5/2	$27+22(^3G)^4F+17(^3H)^4G$			41,655	41,870	−215	0.58	0.796
	7/2	$26+26(^3G)^4F+13(^3H)^4G$			41,758	41,957	−199	1.03	1.102
	9/2	$29+18(^3G)^4F+18(^3H)^4G$			41,861	42,031	−170	1.20	1.239
	11/2	$52+30(^3H)^4G$			41,918	41,954	−36	1.20	1.267
$^4P(^1P)^4P$	1/2	$43+39(^3D)^4P$		$v\,^4P$	41,752	42,087	−335	2.56	2.467
	3/2	$39+38(^3D)^4P$			41,848	42,135	−287	1.62	1.652
	5/2	$38+40(^3D)^4P$			42,010	42,211	−201	1.48	1.572
$^4P(^1P)^4D$	1/2	$53+17(^3F)^4D^*$	$3d^34s(a\,^5P)4p$	$r\,^4D$	41,928	42,095	−167	0.04	0.164
	3/2	$49+16(^3F)^4D^*$			41,999	42,164	−165	1.20	1.267
	5/2	$51+16(^3F)^4D^*$			42,138	42,240	−102	1.33	1.394
	7/2	$58+18(^3F)^4D^*$			42,246	42,327	−81	1.36	1.427
$^4P(^3P)^2S$	1/2	$83+10(A^3P)^2S$		$w\,^2S$	42,362	42,279	83	1.50?	2.020
$^4P(^1P)^4S$	3/2	$70+14(A^3P)^4S$	$3d^34s(a\,^5P)4p$	$w\,^4S$	42,969	42,879	90	1.94	1.993
$(^1I)^2K$	13/2	100				43,678			0.934
	15/2	100				43,800			1.067
$(A^1G)^2F$	5/2	$40+28(A^3F)^2F$				43,857			0.858
	7/2	$37+25(A^3F)^2F$				43,818			1.111
$(^3D)^4F$	3/2	$73+18(^3G)^4F$				43,921			0.412
	5/2	$72+18(^3G)^4F$				43,946			1.033
	7/2	$72+18(^3G)^4F$				43,985			1.238
	9/2	$73+19(^3G)^4F$				44,033			1.333
$(A^1G)^2H$	9/2	$58+10(^3H)^2H$				44,112			0.959
	11/2	$40+38(^1I)^2I$				44,090			1.009
$(^3F)^2G^*$	7/2	$25+24(^3G)^2G+15^2H(^1P)^2G$				44,173			0.923
	9/2	$21+19(^3G)^2G+16(A^1G)^2H$				44,180			1.064
$(^3F)^2D^*$	3/2	$26+18(A^3P)^2D+17A^2D(^3P)^2D$				44,103			0.799
	5/2	$24+18(A^3P)^2D+17A^2D(^3P)^2D$				44,396			1.199
$(^1I)^2I$	11/2	$39+37(^3H)^2H$				44,263			1.006
	13/2	$78+15^2H(^1P)^2I$				44,226			1.077

Name	J	Percentage	AEL		Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
			Config.	Desig.					
$(^3D)^2D$	3/2	$41+32(^3D)^4D$				44,398			0.965
	5/2	$57+16^2P(^1P)^2D+8(^3D)^4D$				44,265			1.209
$(^3D)^4D$	1/2	$77+16A^2D(^3P)^4D$				44,435			0.002
	3/2	$45+28(^3D)^2D+9A^2D(^3P)^4D$				44,474			1.028
	5/2	$70+12A^2D(^3P)^4D$				44,466			1.355
	7/2	$75+13A^2D(^3P)^4D$				44,470			1.425
$(^3F)^4G^*$	5/2	$49+33^2F(^3P)^4G$				44,501			0.575
	7/2	$47+35^2F(^3P)^4G$				44,592			0.985
	9/2	$45+38^2F(^3P)^4G$				44,706			1.172
	11/2	$42+41^2F(^3P)^4G$				44,844			1.272
$(A^1G)^2G$	7/2	$42+16^2H(^1P)^2G$				44,919			0.891
	9/2	$36+17^2H(^1P)^2G$				44,961			1.112
$(A^1S)^2P$	1/2	$65+15(^3D)^2P$				45,179			0.667
	3/2	$65+14(^3D)^2P$				45,277			1.333
$^2F(^3P)^4F$	3/2	$83+9(^3G)^4F$				45,485			0.401
	5/2	$82+9(^3G)^4F$				45,487			1.027
	7/2	$82+9(^3G)^4F$				45,492			1.236
	9/2	$81+9(^3G)^4F$				45,501			1.329
$(^3F)^2F^*$	5/2	$39+28(^3D)^2F$				45,608			0.859
	7/2	$41+29(^3D)^2F$				45,776			1.143
$^2F(^3P)^2D$	3/2	$28+34(A^1D)^2D$				46,078			0.808
	5/2	$26+31(A^1D)^2D$				46,035			1.223
$(^3D)^4P$	1/2	$48+40^4P(^1P)^4P$				46,158			2.622
	3/2	$48+41^4P(^1P)^4P$				46,148			1.721
	5/2	$44+41^4P(^1P)^4P$				46,122			1.575
$^2P(^1P)^2P$	1/2	$29+15A^2D(^1P)^2P$				46,478			0.705
	3/2	$26+11^2F(^3P)^4D$ $+14A^2D(^1P)^2P$				46,753			1.317
$^2F(^3P)^4D$	1/2	$80+5(^3D)^4D$				46,775			0.008
	3/2	$70+4(^3D)^4D$				46,730			1.218
	5/2	$80+5(^3D)^4D$				46,687			1.370
	7/2	$79+6(^3D)^4D$				46,613			1.426
$A^2D(^1P)^2F$	5/2	$19+28^2F(^3P)^4G+17(A^1D)^2F$				46,955			0.722
	7/2	$16+19(A^1D)^2F+11(A^1G)^2F$				46,917			1.137
$^2F(^3P)^4G$	5/2	$31+18(^3F)^4G^*+14(A^1D)^2F$				46,893			0.709
	7/2	$54+34(^3F)^4F^*$				46,968			0.992
	9/2	$54+39(^3F)^4G^*$				47,056			1.172
	11/2	$51+42(^3F)^4G^*$				47,179			1.273
$^2P(^1P)^2S$	1/2	$55+19(^3P)^2S^*$				47,278			1.989
$(^1I)^2H$	9/2	$19+25^2G(^1P)^2H+16^2H(^1P)^2H$				47,486			0.938
	11/2	$23+31^2G(^1P)^2H+17^2H(^1P)^2H$				47,565			1.090
$(^3F)^4F^*$	3/2	$75+15^4F(^1P)^4F$				47,501			0.406
	5/2	$75+14^4F(^1P)^4F$				47,617			1.030

TABLE 2. *Observed and calculated levels of* V I (3d + 4s)^{4}4p – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
	7/2	71 + 15^{4}F(^{1}P)^{4}F				47,771			1.218
	9/2	63 + 14^{4}F(^{1}P)^{4}F				47,960			1.294
^{2}G(^{1}P)^{2}G	7/2	32 + 18(A^{1}G)^{2}G + 10(^{3}G)^{2}G				47,584			0.910
	9/2	24 + 14(A^{1}G)^{2}G + 12(^{3}F)^{4}F*				47,780			1.120
^{2}F(^{3}P)^{2}G	7/2	63 + 13(^{1}F)^{2}G				48,054			0.890
	9/2	62 + 15(^{1}F)^{2}G				48,148			1.111
(A^{1}D)^{2}D	3/2	37 + 23^{2}F(^{1}P)^{2}D + 20(^{3}F)^{2}D*				48,125			0.795
	5/2	36 + 24^{2}F(^{1}P)^{2}D + 18(^{3}F)^{2}D*				48,205			1.192
(A^{1}D)^{2}F	5/2	34 + 19(^{1}F)^{2}F + 18^{2}F(^{1}P)^{2}F				48,606			0.858
	7/2	30 + 21(^{1}F)^{2}F + 21^{2}F(^{1}P)^{2}F				48,670			1.142
^{2}H(^{1}P)^{2}I	11/2	86 + 11(^{1}I)^{2}I				49,312			0.924
	13/2	87 + 11(^{1}I)^{2}I				49,440			1.077
^{2}F(^{3}P)^{2}F	5/2	60 + 15(A^{1}D)^{2}F				49,365			0.858
	7/2	56 + 18(A^{1}D)^{2}F				49,471			1.143
A^{2}D(^{1}P)^{2}P	1/2	20 + 21(^{3}D)^{2}P + 15(^{1}D)^{2}P*				49,563			0.675
	3/2	19 + 19(^{3}D)^{2}P + 15(^{1}D)^{2}P*				49,464			1.331
^{2}H(^{1}P)^{2}H	9/2	49 + 35(^{1}I)^{2}H				49,845			0.910
	11/2	51 + 33(^{1}I)^{2}H				49,881			1.091
^{2}P(^{1}P)^{2}D	3/2	38 + 15(^{3}D)^{2}D				49,973			0.806
	5/2	39 + 15(^{3}D)^{2}D				50,019			1.194
(A^{1}D)^{2}P	1/2	56 + 20^{2}P(^{1}P)^{2}P				50,919			0.667
	3/2	52 + 20^{2}P(^{1}P)^{2}P				51,076			1.328
(^{1}F)^{2}F	5/2	39 + 20A^{2}D(^{1}P)^{2}F				51,266			0.863
	7/2	38 + 19A^{2}D(^{1}P)^{2}F				51,209			1.143
^{2}G(^{1}P)^{2}F	5/2	19 + 17(^{1}F)^{2}F + 10(^{3}D)^{2}F				51,452			0.860
	7/2	19 + 17(^{1}F)^{2}F + 10(^{3}F)^{2}F*				51,611			1.145
(^{3}F)^{4}D*	1/2	56 + 19^{4}P(^{1}P)^{4}D				51,751			0.001
	3/2	55 + 18^{4}P(^{1}P)^{4}D				51,796			1.192
	5/2	54 + 18^{4}P(^{1}P)^{4}D				51,883			1.364
	7/2	54 + 17^{4}P(^{1}P)^{4}D				52,026			1.425
(^{1}F)^{2}G	7/2	68 + 18^{2}F(^{1}P)^{2}G				52,108			0.890
	9/2	69 + 18^{2}F(^{1}P)^{2}G				52,243			1.111
A^{2}D(^{1}P)^{2}D	3/2	19 + 19(^{3}F)^{2}D* + 17(^{1}F)^{2}D				52,424			0.808
	5/2	17 + 20(^{1}F)^{2}D + 20(^{3}F)^{2}D*				52,563			1.203
(B^{3}P)^{2}D	3/2	47 + 30^{2}F(^{1}P)^{2}D				52,684			0.801
	5/2	47 + 30^{2}F(^{1}P)^{2}D				52,541			1.202
(B^{3}P)^{4}P	1/2	90				54,607			2.661
	3/2	90				54,572			1.730
	5/2	89				54,548			1.598
(^{1}F)^{2}D	3/2	28 + 26(B^{3}F)^{2}D				55,068			0.773
	5/2	26 + 27(B^{3}F)^{2}D				54,936			1.199

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
^{2}H(^{1}P)^{2}G	7/2	18+23(^{3}F)^{2}G* +16(^{1}G)^{2}G*				55,259			0.900
	9/2	19+23(^{3}F)^{2}G* +16(^{1}G)^{2}G*				55,432			1.118
(B^{3}F)^{4}F	3/2	89				55,447			0.443
	5/2	82+6(^{3}F)^{4}F*				55,439			1.054
	7/2	60+15(B^{3}P)^{4}D				55,423			1.284
	9/2	83+7(^{3}F)^{4}F*				55,476			1.327
(B^{3}P)^{4}D	1/2	49+33(B^{3}F)^{4}D				55,580			0.004
	3/2	48+30(B^{3}F)^{4}D				55,575			1.188
	5/2	45+29(B^{3}F)^{4}D				55,559			1.343
	7/2	36+30(B^{3}F)^{4}D				55,524			1.371
^{2}F(^{1}P)^{2}F	5/2	20+26(B^{3}F)^{2}F+10(^{1}D)^{2}F*				55,658			0.840
	7/2	16+21(B^{3}F)^{4}G+19(B^{3}F)^{2}F				55,804			1.094
(B^{3}P)^{2}S	1/2	52+37(^{3}P)^{2}S*				55,852			1.997
(B^{3}F)^{4}G	5/2	87				55,919			0.596
	7/2	66+15(B^{3}F)^{2}F				55,930			1.034
	9/2	91				56,005			1.170
	11/2	95				56,062			1.273
(B^{3}F)^{4}D	1/2	36+26B^{2}D(^{3}P)^{4}D				56,483			0.001
	3/2	37+26B^{2}D(^{3}P)^{4}D				56,474			1.199
	5/2	37+25B^{2}D(^{3}P)^{4}D				56,452			1.371
	7/2	38+24B^{2}D(^{3}P)^{4}D				56,406			1.428
(B^{3}F)^{2}F	5/2	36+22(^{1}D)^{2}F* +19^{2}F(^{1}P)^{2}F				58,583			0.867
	7/2	35+21(^{1}D)^{2}F* +20^{2}F(^{1}P)^{2}F				57,555			1.128
(B^{3}F)^{2}D	3/2	25+20(^{1}F)^{2}D+14^{2}F(^{1}P)^{2}D				57,650			0.859
	5/2	24+22(^{1}F)^{2}D+14^{2}F(^{1}P)^{2}D				57,726			1.190
(B^{3}P)^{4}S	3/2	44+29(B^{3}P)^{2}P				57,885			1.626
^{2}F(^{1}P)^{2}G	7/2	29+32(B^{3}F)^{2}G+15(^{3}F)^{2}G*				57,854			0.903
	9/2	31+40(B^{3}F)^{2}G				58,042			1.111
(B^{3}P)^{2}P	1/2	67+23(^{1}D)^{2}P*				58,037			0.669
	3/2	34+42(B^{3}P)^{4}S				57,974			1.648
(B^{3}F)^{2}G	7/2	55+23^{2}F(^{1}P)^{2}G				58,145			0.891
	9/2	45+23^{2}F(^{1}P)^{2}G				57,897			1.111
(^{1}D)^{2}D*	3/2	54+14B^{2}D(^{1}P)^{2}D				59,061			0.810
	5/2	46+13B^{2}D(^{1}P)^{2}D				59,106			1.172
(^{1}D)^{2}F*	5/2	20+19(B^{1}G)^{2}F+8(^{1}D)^{2}D*				59,350			1.003
	7/2	18+19(B^{1}G)^{2}F +16B^{2}D(^{3}P)^{4}D				59,266			1.255
B^{2}D(^{3}P)^{4}D	1/2	38+36(^{3}P)^{4}D* +20(B^{3}F)^{4}D				59,237			0.001
	3/2	38+34(^{3}P)^{4}D* +19(B^{3}F)^{4}D				59,270			1.192
	5/2	31+25(^{3}P)^{4}D* +18(B^{3}F)^{4}D				59,344			1.254
	7/2	26+18(^{3}P)^{4}D* +13(^{1}D)^{2}F*				59,450			1.316

Name	J	Percentage	AEL		Obs. level (cm^{-1})	Calc. level (cm^{-1})	O−C	Obs. g-factor	Calc. g-factor
			Config.	Desig.					
(B^{1}G)^{2}H	9/2	88+6(^{1}G)^{2}H*				59,575			0.910
	11/2	88+6(^{1}G)^{2}H*				59,722			1.091
B^{2}D(^{3}P)^{4}F	3/2	93				60,177			0.401
	5/2	93				60,185			1.029
	7/2	92				60,199			1.238
	9/2	93				60,222			1.333
B^{2}D(^{3}P)^{4}P	1/2	49+23(^{3}P)^{4}P*				60,550			2.472
	3/2	38+16(^{3}P)^{4}P*+15(B^{1}D)^{2}D				60,617			1.311
	5/2	41+16(^{3}P)^{4}P*				60,522			1.432
^{2}F(^{1}P)^{2}D	3/2	20+24B^{2}D(^{3}P)^{4}P +16B^{2}D(^{3}P)^{2}D				60,586			1.218
	5/2	20+23B^{2}D(^{3}P)^{4}P +19B^{2}D(^{3}P)^{2}D				60,633			1.366
(^{3}P)^{4}S*	3/2	41+20(^{1}D)^{2}P*+11^{4}P(^{1}P)^{4}S				60,619			1.687
(^{3}P)^{2}S*	1/2	24+30(B^{3}P)^{2}S+19B^{2}D(^{3}P)^{4}P				60,660			2.076
(^{1}D)^{2}P*	1/2	40+13(B^{3}P)^{2}P				61,113			0.754
	3/2	24+35(^{3}P)^{4}S*				60,917			1.628
(^{3}P)^{4}D*	1/2	47+24B^{2}D(^{3}P)^{4}D				61,102			0.032
	3/2	42+21B^{2}D(^{3}P)^{4}D				61,123			1.157
	5/2	41+18B^{2}D(^{3}P)^{4}D				61,165			1.334
	7/2	55+21B^{2}D(^{3}P)^{4}D				61,229			1.424
B^{2}D(^{3}P)^{2}D	3/2	44+16(^{3}P)^{2}D*				61,292			0.863
	5/2	39+15(^{3}P)^{2}D*				61,329			1.237
B^{2}D(^{3}P)^{2}F	5/2	57+17(B^{1}G)^{2}F				61,707			0.859
	7/2	47+16(B^{1}G)^{2}F				61,720			1.117
(B^{1}G)^{2}G	7/2	67+18^{2}F(^{1}P)^{2}G				61,950			0.919
	9/2	71+20^{2}F(^{1}P)^{2}G				61,977			1.111
(^{3}P)^{2}P*	1/2	73+21B^{2}D(^{3}P)^{2}P				63,190			0.667
	3/2	73+22B^{2}D(^{3}P)^{2}P				63,184			1.333
(^{3}P)^{4}P*	1/2	62+30B^{2}D(^{3}P)^{4}P				63,541			2.665
	3/2	64+29B^{2}D(^{3}P)^{4}P				63,560			1.733
	5/2	66+26B^{2}D(^{3}P)^{4}P				63,600			1.599
(B^{1}G)^{2}F	5/2	28+27B^{2}D(^{3}P)^{2}F+25^{2}F(^{1}P)^{2}F				65,001			0.857
	7/2	27+27B^{2}D(^{3}P)^{2}F+24^{2}F(^{1}P)^{2}F				65,013			1.143
(^{1}G)^{2}G*	7/2	67+13^{2}H(^{1}P)^{2}G				65,450			0.889
	9/2	66+15^{2}H(^{1}P)^{2}G				65,465			1.110
B^{2}D(^{3}P)^{2}P	1/2	93				66,142			0.667
	3/2	93				66,126			1.333
(^{1}G)^{2}H*	9/2	89+8(B^{1}G)^{2}H				66,065			0.910
	11/2	90+8(B^{1}G)^{2}H				66,210			1.091

TABLE 2. *Observed and calculated levels of* V I $(3d+4s)^4 4p$ – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. level (cm^{-1})	Calc. level (cm^{-1})	O–C	Obs. g-factor	Calc. g-factor
$(^3P)^2D^*$	3/2	$29+32^2F(^1P)^2D+12(^1D)^2D^*$				67,350			0.800
	5/2	$29+31^2F(^1P)^2D+12(^1D)^2D^*$				67,266			1.200
$(^1G)^2F^*$	5/2	$55+23B^2D(^1P)^2F$				68,160			0.857
	7/2	$55+24B^2D(^1P)^2F$				68,130			1.143
$(B^1D)^2P$	1/2	$79+7(^3P)^2P^*$				70,861			0.667
	3/2	$79+7(^3P)^2P^*$				70,768			1.333
$(B^1D)^2F$	5/2	$87+5(^1G)^2F^*$				71,444			0.858
	7/2	$87+5(^1G)^2F^*$				71,575			1.143
$(B^1D)^2D$	3/2	$65+27B^2D(^1P)^2D$				72,521			0.800
	5/2	$63+28B^2D(^1P)^2D$				72,560			1.199
$B^2D(^1P)^2D$	3/2	$56+26(B^1D)^2D$				75,334			0.803
	5/2	$55+26(B^1D)^2D$				75,357			1.200
$B^2D(^1P)^2P$	1/2	$49+13(^1S)^2P^*$				75,908			0.667
	3/2	$48+14(B^1S)^2P$				75,925			1.330
$B^2D(^1P)^2F$	5/2	$67+22(^1G)^2F^*$				76,208			0.857
	7/2	$67+22(^1G)^2F^*$				76,100			1.143
$(B^1S)^2P$	1/2	$66+24B^2D(^1P)^2P$				84,425			0.667
	3/2	$66+23B^2D(^1P)^2P$				84,548			1.333
$(^1S)^2P^*$	1/2	$79+15(B^1S)^2P$				91,043			0.667
	3/2	$79+16(B^1S)^2P$				91,193			1.333

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